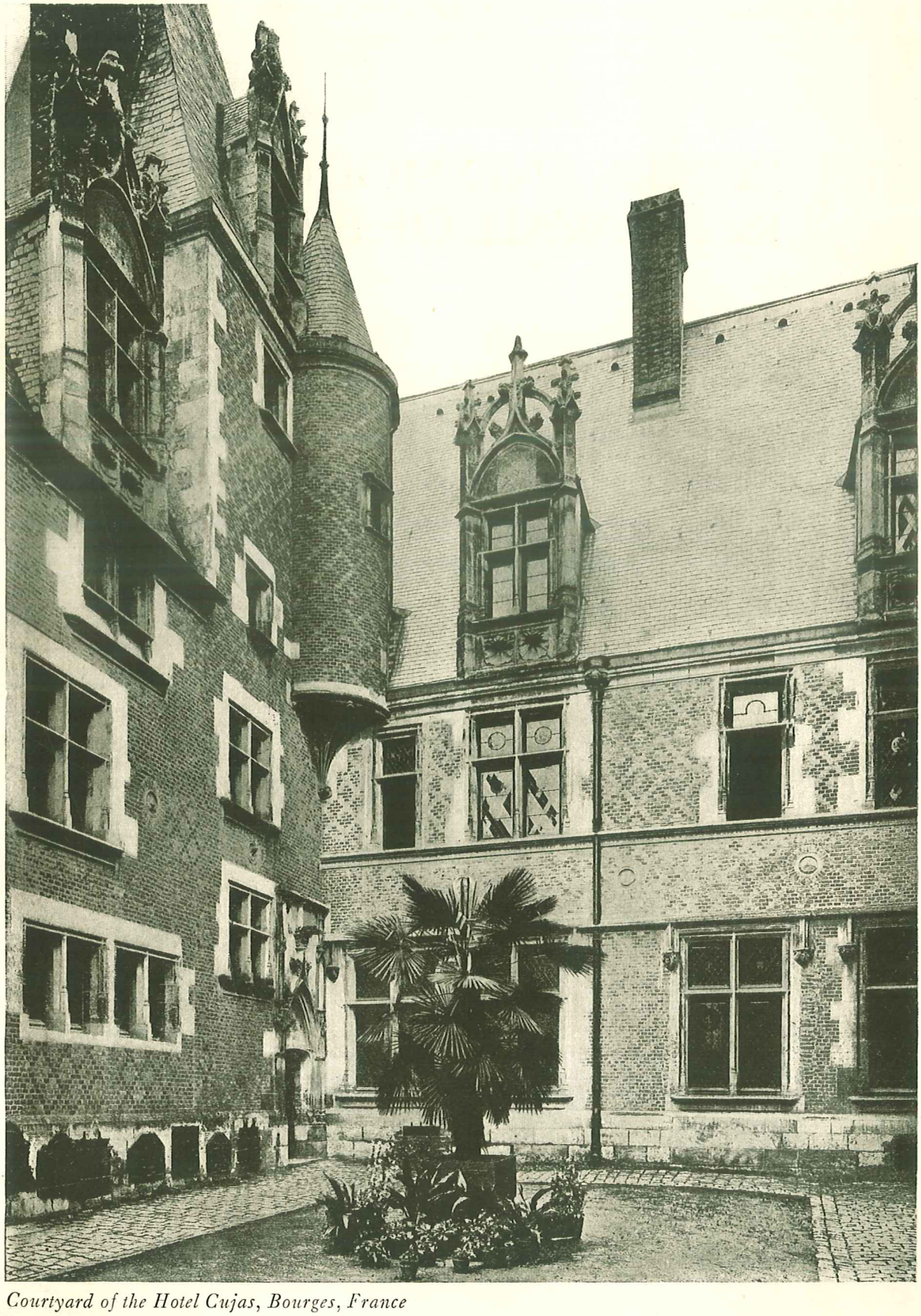
BONDS AND MORTARS IN THE WALL OF BRICK



Courtyard of the Hotel Cujas, Bourges, France

BONDS AND MORTARS IN THE WALL OF BRICK

AN ESSAY ON DESIGN IN PATTERNS FOR BRICKWORK

HYDRAULIC-PRESS BRICK COMPANY
SAINT LOUIS

BONDS AND MORTARS
IN THE WALL OF BRICK

I.

DESIGN in brickwork is based on an accurate knowledge of the mechanical processes of the bond. Bond may be defined as the method by which each brick in the wall is so placed that the entire wall, by the overlapping of the individual bricks upon each other, forms one solid mass throughout its length and breadth. The bricks laid with the length of the wall, or the stretchers as they are called, secure by their overlap longitudinal bonding strength, while those laid across the width of the wall, or the headers, bond the wall transversely.

As a pure Running Bond, or one made up entirely of stretchers, provides only for longitudinal strength, we may be justified in saying that all structurally sound brickwork is based on either one of two methods of bonding, both of which systematically include headers with the stretchers throughout the courses. The first is known as English Bond, and consists of alternating courses of headers and stretchers; the second is the Flemish Bond, consisting of alternating headers and stretchers in every course, so arranged that the headers and stretchers in every other course, respectively, appear in vertical lines. All ornamental bonds are simply variations of these two fundamental forms.

It is essential, however, that the designer of ornamental brickwork should be cautioned not to confuse bond and pattern. Bond refers primarily to the arrangement of the bricks as they overlap each other from course to course. It is true, bond may be frequently used to make various patterns by this arrangement; but, in the strict sense of the term, pattern refers to the change, or the varied arrangement, of the brick texture or color used in the facing; so that in this way it may be possible to secure many patterns in identically the same bond. Pattern may also be produced by the handling of the mortar joint, or by the projection or recession of certain bricks from the plane of the wall—a form of pattern used especially in the Moorish and Spanish brickwork.

CLASSIFICATION OF BONDS

Running or Stretcher Bond (Diagram 1) consists entirely of stretchers overlapping each other one half brick, that is, breaking joint evenly, with the vertical joints in alternate courses forming perpendicular lines. Obviously lacking inherent transverse strength, this bond is suitable for use in wall facing only, which must be tied to the backing by some artificial means. The questionable practice of using metal wall ties and the method of clipping the interior corners of the facing brick to permit the insertion of diagonal headers into the backing are illustrated in Diagram 2; so also is the occasional use of a bonding brick, made of double width for this special purpose. To remedy the transverse weakness of this bond, a header—sometimes a Flemish—course is introduced at regular intervals, generally every sixth or eighth course, resulting in what is known as Common Bond (Diagram 3 shown with three intervening courses), which affords a perfectly satisfactory bonding strength in the wall transversely as well as longitudinally. Another form of Running Bond is given in Diagram 4. Here the stretchers overlap only a quarter brick, or are crossed one-half instead of being wholly crossed as in Diagram 1. This bond is very rarely used for any large surface, but frequently occurs in two or three courses separated by a Flemish or a header course, approaching in its nature the Common Bond.

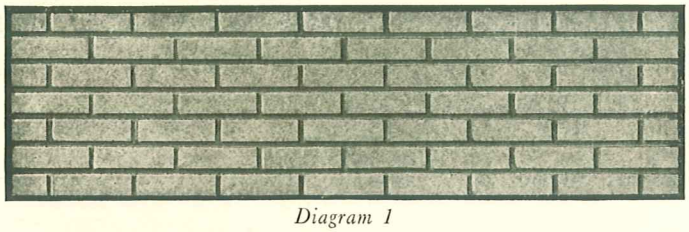


Diagram 1

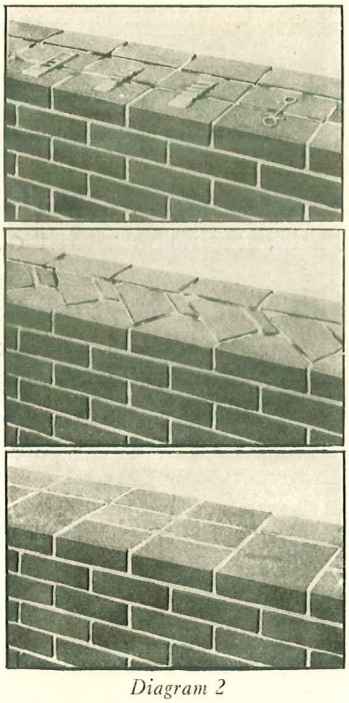


Diagram 2

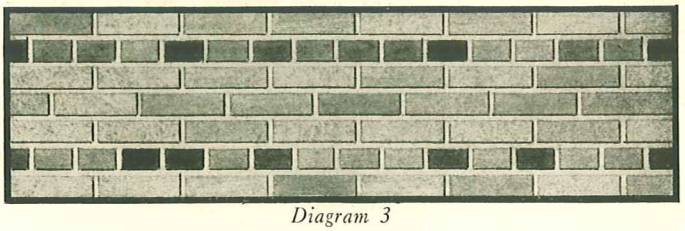


Diagram 3

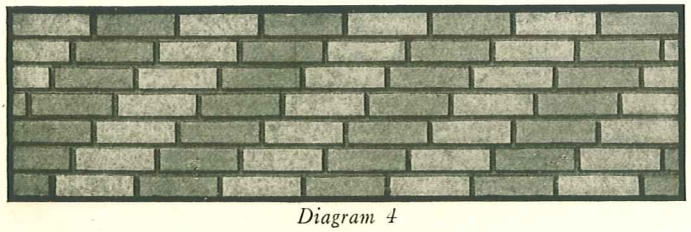


Diagram 4

Diagram 5 shows a running Header Bond worked by the brick texture or color as a zigzag. In Diagram 6 we have headers laid without any bond at all in vertical lines, producing a reticulated appearance and forming what is known as Checker-Board Bond. Although it is sometimes used in wall surfaces, it is merely ornamental and does not strictly come under the definition of bond. It should properly be used only in panels or contained areas.

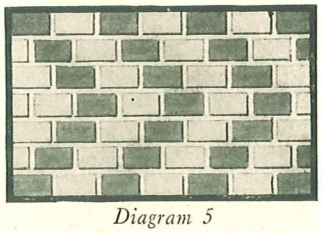


Diagram 5

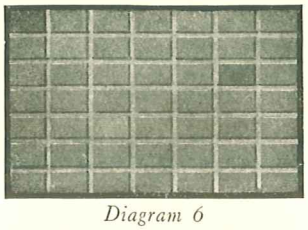


Diagram 6

English Bond (Diagram 7), already mentioned as one of the two basic methods of bonding, consists of alternating courses of headers and stretchers, with headers centered on the stretchers which lie in vertical lines. The tinting of the diagram shows two possible patterns which may be obtained by change in color or texture of the brick. English Bond presents serious practical difficulties in case two headers with the mortar joint, as may frequently happen, occupy a greater space than the length of the stretcher, thus making it exceedingly difficult to secure the desired alignment in the vertical joints.

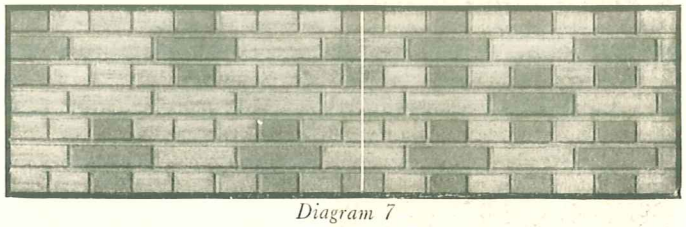


Diagram 7

English Cross Bond (Diagram 8), referred to by some builders as Dutch or Dutch Cross Bond, is a modification of English Bond in which the stretchers are crossed; that is, break joint evenly in the successive stretcher courses. The same practical difficulty applies to this as to English Bond. Diagrams 7 and 8 are drawn so as to show two headers with the joint as being exactly equal in length to the stretcher. Diagram 8 shows two pattern arrangements which may be made in English Cross Bond, dependent upon handling color or texture.

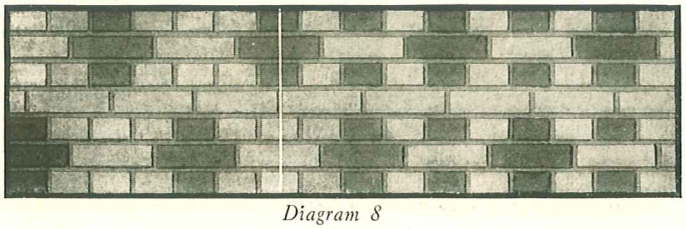


Diagram 8

Flemish Bond (Diagram 9), already mentioned

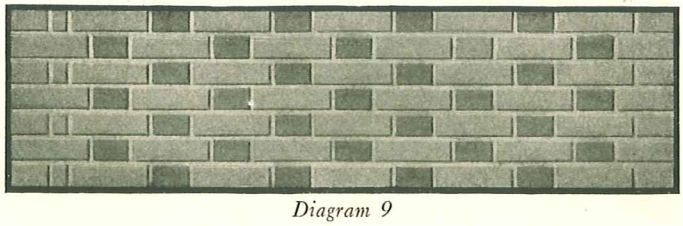


Diagram 9

as the second basic method of bonding, consists of alternating headers and stretchers in all the courses of the wall, and these are known as Flemish courses. There are two legitimate methods of starting the corner in this bond, both of which are frequently used on the same work. The left end of the diagram shows the use of a quarter-brick, or "queen" closer, known as the "clip." The right end shows the use of the three-quarter brick, or "king" closer. There should be no variation in color, however, between the clip as shown on the left-hand edge and the general wall color of the course. Pattern in this bond should be made only by the headers. The closer at the corners should never be included as part of the pattern. It should be stated in passing that the brick designer must exercise great care in the use of his quarter-brick closer or clip in beginning or ending his courses at corners or edges of openings. He may without scruple begin or end his course with a three-quarter brick if necessary, but in case the clip is needed to complete the bond, it should never, except under the most pressing necessity of pattern requirements, be permitted to take the corner. Its best position is next the corner brick, as seen in the left-hand edge of the diagram.

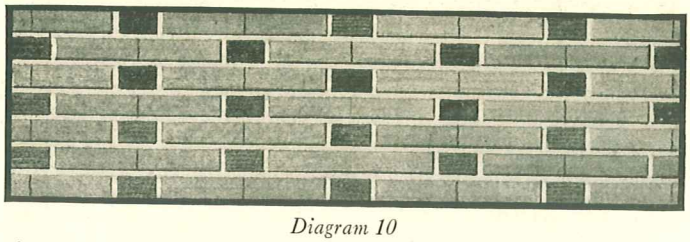


Diagram 10

Flemish Bond may be modified by doubling the stretchers in every course (Diagram 10) and centering the headers over the stretcher joints, which are always concealed or "blind"—in this particular alone differing from a Double-Stretcher Garden Wall Bond (see under Diagram 16).

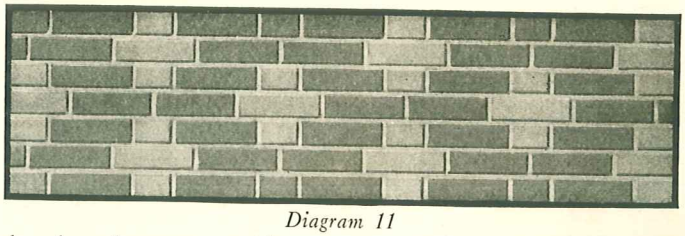


Diagram 11

Flemish Bond with its variations is the basis of most pattern bond, which largely depends upon crossing the simple Flemish Bond by first introducing variously crossed stretcher courses between the Flemish courses and then shifting the Flemish header in one of several different ways, or allowing it to remain in a vertical line.

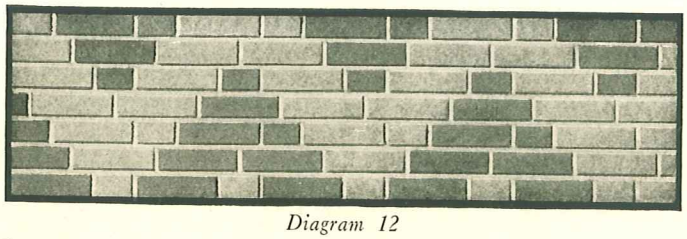


Diagram 12

Thus in Diagram 11 we have the simplest form of

Flemish Cross Bond which consists of alternating Flemish and stretcher courses with the headers in vertical lines and the stretcher courses crossed. In Diagram 12 we have the same arrangement of crossed stretcher courses, but the Flemish header departs from the vertical line by being shifted back and forth its width. This bond is the beginning of all *diagonal* pattern bonds, which owe their variation chiefly to the number and treatment of intervening stretcher courses, and to the way in which the header is shifted. In Diagram 13 a Flemish course alternates with two stretcher courses which have an overlap of a quarter brick and reverse the diagonal direction of their vertical joints after every Flemish course, while the header is shifted back and forth three-quarters of a brick.

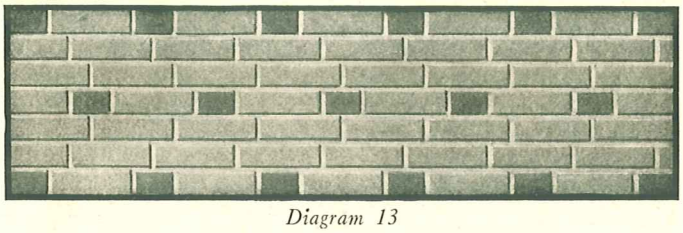


Diagram 13

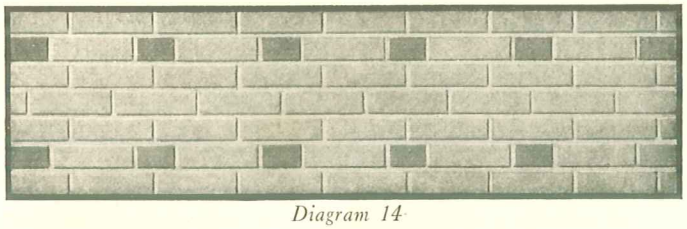


Diagram 14

Diagram 14 represents a bond in which Flemish courses alternate with groups of three stretcher courses. This is a very satisfactory bond for average brickwork, as the headers are frequent enough to tie sufficiently the facing to the backing brick, and the work can easily be laid out so as to fit average building conditions without serious trouble (see under Diagram 4 and Diagram 3). Diagram 15 shows a Flemish Spiral Bond, having the Flemish courses laid out so that the headers break joint over each other and form diagonal bands on the face of the wall—a bond that is frequently used for stair-towers and chimneys.

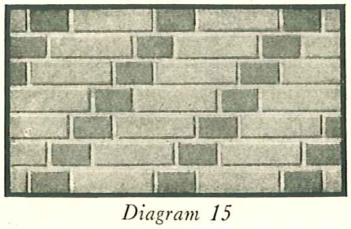


Diagram 15

In Diagram 16 we have Garden Wall Bond, which was originally used in eight-inch garden walls. Its value lies in its longitudinal strength, with sufficient transverse bonding secured by a symmetrical placing of the headers. By this arrangement a wall is laid in which both faces present

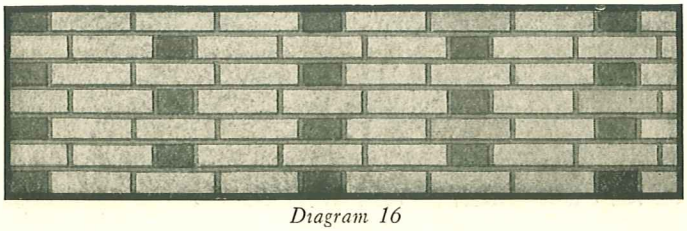


Diagram 16

a like bond surface. The diagram shows the original form of this bond, consisting properly of three stretchers alternating with a header in each course, although it is sometimes laid with two stretchers and a header—then designated as Double-Stretcher Garden Wall Bond—in which case it forms the basis of Double-Stretcher Flemish Bond as given in Diagram 10.

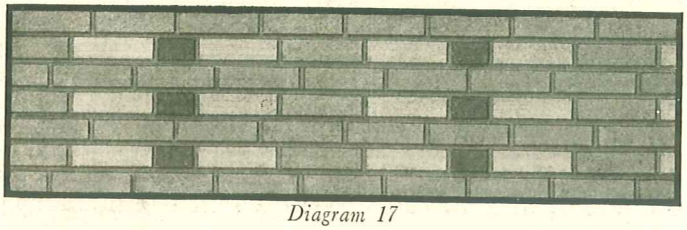


Diagram 17

Garden Wall Bond may also be laid with four or even five stretchers between the header.

Diagram 17 is a representation of Garden Wall Cross Bond, which consists of Garden Wall courses alternating with stretcher courses crossed. One form of pattern frequently used in this bond is indicated.

BOND PATTERN UNITS

Diagram 18, which is an adaptation of the unit system used by Gilbreth in the work cited below, represents the various units or "eyes" upon which all diagonal bonds are based. Beginning with Unit I, which is composed of a stretcher with a header centered above and below it, each succeeding unit is formed by extending every course of the preceding unit the width of a header, always centering the courses on the middle course regarded as the horizontal axis of the unit, and terminating the whole above and below by a header.

As a result the units, however far they may be carried out, always present exact mathematical proportions and bear a definite relation to each other. The serial number of any particular unit may at once be known by subtracting one from its number of courses and dividing by two; or, more simply, by counting the number of courses either above or below the horizontal axis. Conversely, the number of courses in any given unit may be known by doubling its serial number and adding one. Thus if we discovered in a brick wall a unit of nineteen courses, nine courses on either side of the horizontal axis, we should know that it was Unit IX; or if we wished to use Unit IX, we should always be obliged to have space for nineteen courses; and so on.

It is interesting to note further that the units may also be recognized by their horizontal axes, which in odd-numbered units are always composed entirely of stretchers, while in even-numbered units they always carry one, and only one, header, set as near their center as possible. The serial number of an even-numbered unit is double the number of stretchers in its axis, while

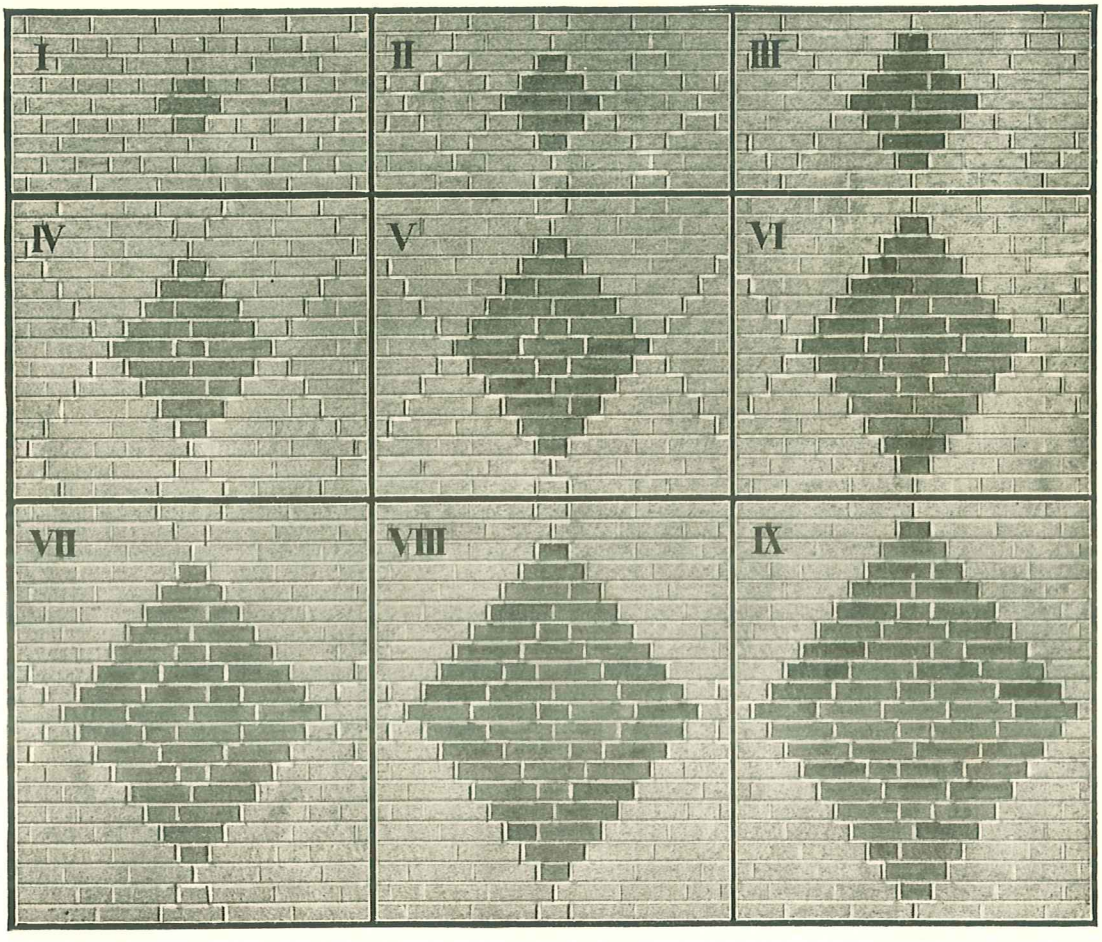


Diagram 18

that of an odd-numbered unit is one less than double the number of its axial stretchers. Thus if we see a unit with a horizontal axis of four stretchers only, we may be sure that it is odd-numbered Unit VII; but if it have four stretchers *and* a header, we know that it is the even-numbered Unit VIII.

With Unit IV there begin to appear units within units. While the header, crossed by vertical stretcher joints, which appears at the center of Unit IV is not strictly a unit in our sense of the term, it is nevertheless the primary unit of all, as the smallest normal element in brickwork. Unit I clearly comes to view as the center of Unit V; Unit II appears in VI; Unit III in VII; and so on. It is by the treatment of these units, each of which in itself is a bond pattern, that various patterns may be worked out on the surface of the wall by the proper handling of the color tones and textures in the brick, or of the mortar joints.

The units may be made to join, or "butt," each other vertically and horizontally; or they may be separated by introducing between them one

or more courses above and below, or variously arranged rows of brick in a general vertical direction on the side, as may be seen in the following diagrams. When separated, the units are said to be surrounded by horizontal and vertical borders. And much of the artistic value of the pattern will depend upon the skill and taste with which these borders are worked out.

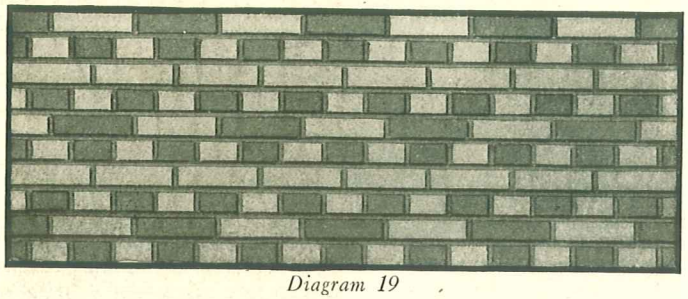


Diagram 19

The designer in brickwork is urged to remember that the use of pattern bonds obligates him to pay the strictest and most thoughtful attention to the beginning and ending of the pattern, either at the bottom or top of the structure, or on piers as they occur separately or between windows. He must first decide on a unit which is suitable to the size of the panel to be covered, and then exactly center it upon the panel, so that his pattern may end in a symmetrical manner, both laterally and vertically. In order to secure vertical symmetry the panel must always have an odd number of courses, that is, an even number on each side of the median line.

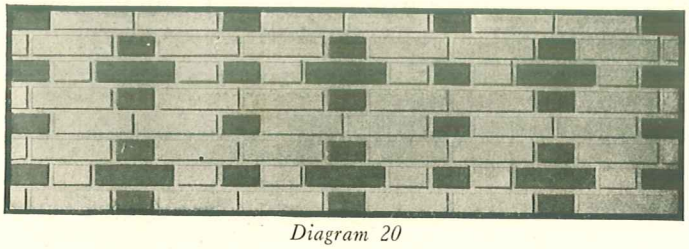


Diagram 20

BOND UNITS IN PATTERN

The accompanying diagrams offer a few suggestions of the way to handle the units, and to treat the color tones and textures of the brick in designing patterns.

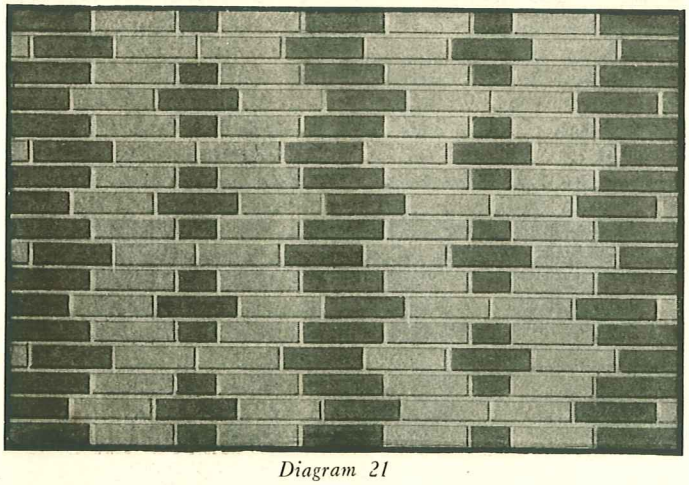


Diagram 21

Diagrams 19, 20, and 21 are readily seen to be examples of Unit I, which, if brought out in the design, always presents the appearance of a St. George's or Greek cross. Diagram 19 is, in bond, identical with

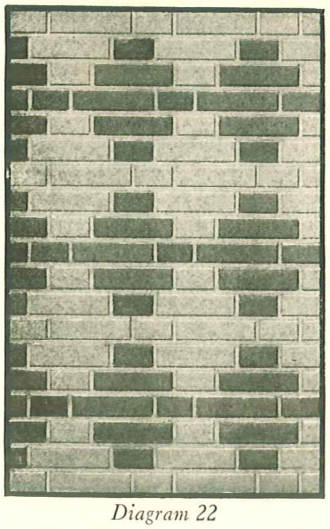


Diagram 22

Diagram 8, or English Cross Bond, and differs from it only by the treatment of the colors in the brick, so arranged as to veil the definition of the units. By comparing the two, it will be seen what different patterns can be woven into the same bond. Diagram 20 is a sort of Garden Wall Bond with the units

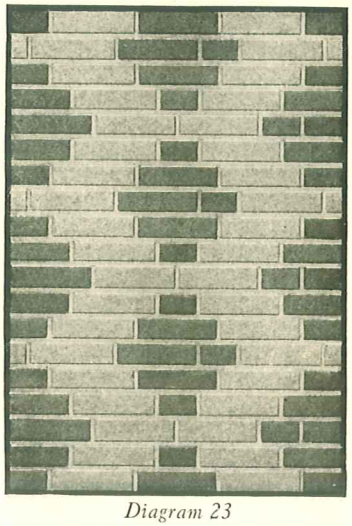


Diagram 23

and certain headers in vertical lines brought out by heightened tones in the color or texture of the brick. In Diagram 21, consisting of alternating crossed stretcher and Garden Wall courses, the unit is also highly accentuated and surrounded by a vertical and horizontal border, but is accompanied by a vertical zigzag of stretchers instead of a vertical line of headers.

In Diagrams 22, 23, and 24 are shown varied treatments of Unit II. Diagram 22, which is a modification of Flemish Bond as seen in Diagram 9, presents a wall surface composed entirely of these units completely dovetailed. Here we have an excellent illustration of the distinction between bond units, as such, and pattern. The bond inevitably works out the *bond units*, and these may be of uniform color or texture throughout the wall; or, as here, brought out by color or texture treatment into distinct *pattern units*, which butt horizontally and are separated vertically by a header-stretcher border. Diagram 23 is a Garden Wall Bond with the units in vertical lines; while Diagram 24 is a Double-Stretcher Garden Wall Bond with the units in diagonal lines. In both there is a horizontal and vertical stretcher border about the units.

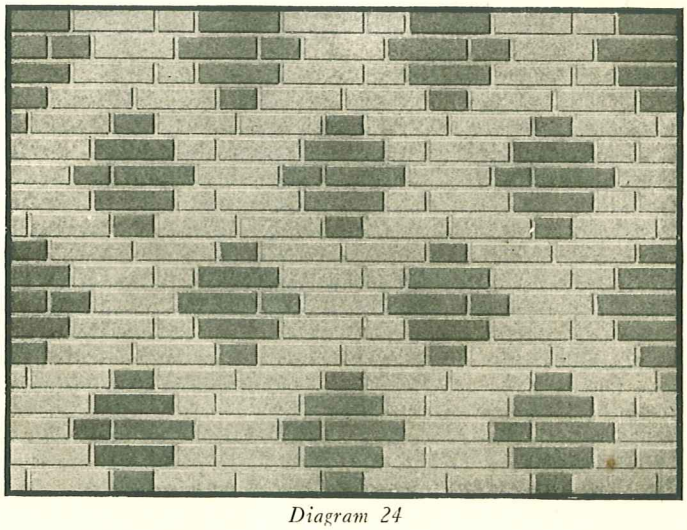


Diagram 24

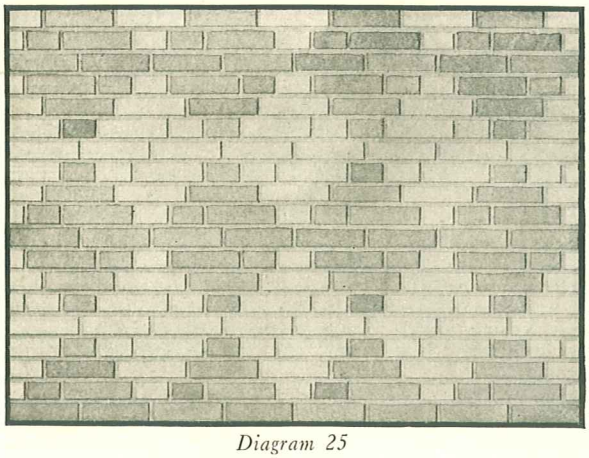


Diagram 25

Diagrams 25, 26, 27, and 28 present a variety of design based on Unit III. Diagram 25 shows a bond of stretcher courses, crossed, alternating with courses of two headers and a stretcher, in which the bond and pattern units have the same dovetailed arrangement as in Diagram 22. Diagram 26 is the same bond as the preceding except that every sixth course is entirely of headers, flanked by uncrossed stretchers. Here, as before, the pattern units butt horizontally but, instead of lying vertically separated by a stretcher course, are set in dovetail fashion and separated vertically by a zigzag line of stretchers and headers.

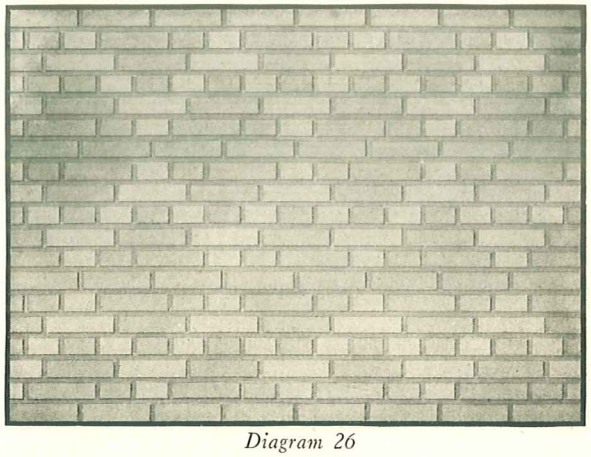


Diagram 26

Diagram 27 presents a very mixed bond in which Flemish and stretcher courses are intermingled regularly with courses of alternating stretchers and four-header groups. The units, deeply dovetailed, are separated horizontally by header and vertically by stretcher borders; and it is interesting to note that the stretcher courses are so set as to form the axial line of one horizontal row of units while serving as the horizontal borders of the next row of units. The pattern in Diagram 28, worked on a bond of alternating Flemish courses and stretcher courses, crossed, shows the units separated by vertical and horizontal stretcher borders that sweep in great interlaced diagonal bands up and down the surface of the wall.

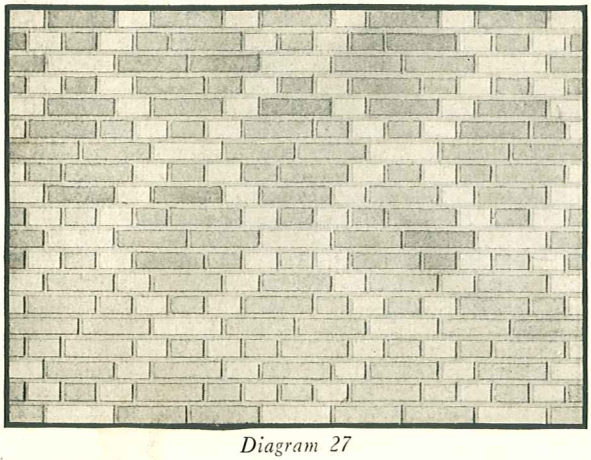


Diagram 27

Nothing could show better than this diagram how really simple is the secret of working out these seemingly complex figures. Once having crossed the alternating stretcher courses, that is, shifted them half a brick each time, it is only a matter of attending to the method of shifting the Flemish courses by watching the movement of the header. Beginning for convenience with the fourth course, because in this diagram the first full unit begins there, it is seen that the header shifts its own width three times to the right and then three times to the left, and so on up the entire wall. It will also be seen that the headers rest alternately on stretchers and stretcher cross-joints, and that, with all the shifting, they never depart from this original position.

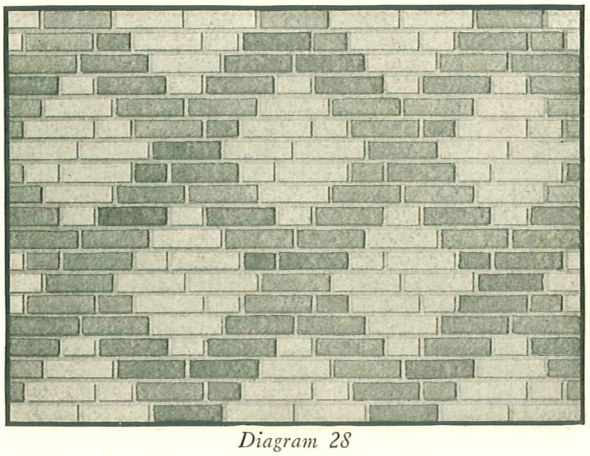


Diagram 28

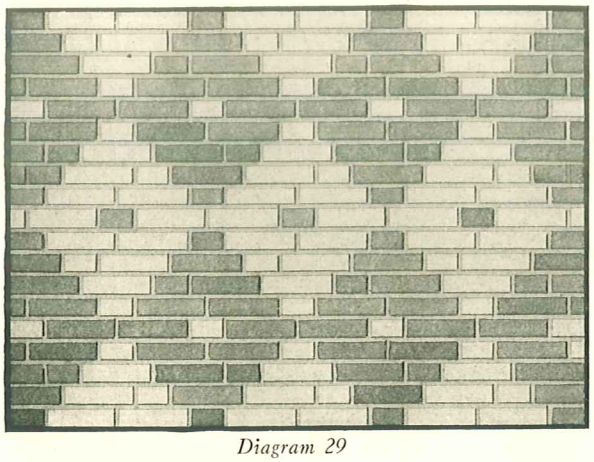


Diagram 29

Diagrams 29, 30, 31, 32, and 33 furnish beautiful examples of Unit IV. Diagram 29 is a Double-Stretcher Garden Wall Bond showing the same arrangement of units as in Diagram 25. And yet aside from the difference in the size of the units employed, there is a striking difference in their appearance when viewed in their relation to the texture of the whole wall surface. In the first instance, the smaller units, with but one distinction of color, are woven together into a compact wall texture. In the second, the larger units, which would be too heavy if thus left solid masses of color, are enlivened by luminous points

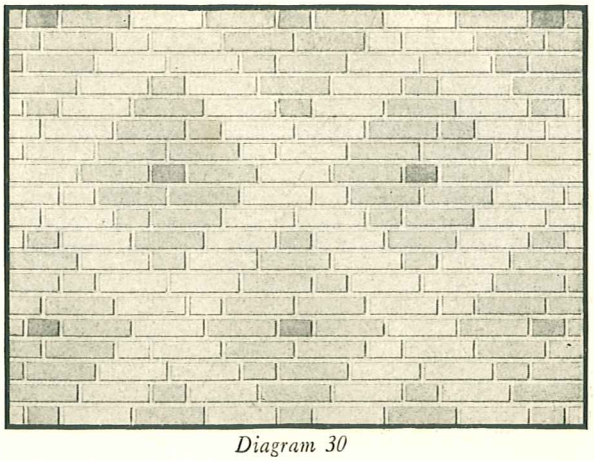


Diagram 30

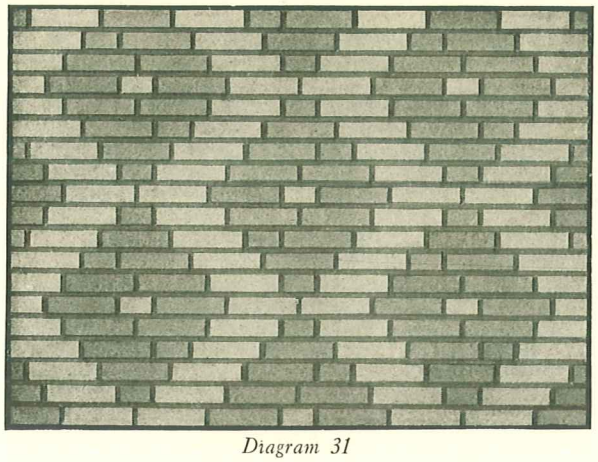


Diagram 31

in their centers, the dark spots giving as much life to the light units as the the light spots do to the dark units. Thus the wall is interlaced as a beautiful fabric and presents the appearance of lightness and vivacity.

Diagram 30 shows a Garden Wall Bond with the units set in dovetailed fashion but surrounded by a stretcher border. Diagram 31, a Four-Stretcher Garden Wall Bond, has the units more deeply dovetailed than they are in Diagram 30, resulting in their being thrust apart horizontally by two stretchers instead of one. They also show a horizontal and vertical stretcher border, and are much enhanced in value by the bright spot in their centers. Diagram 32, a very mixed bond, shows the dovetailed units separated by header borders which form interlacing diagonal lines on the surface of the wall; while Diagram 33, also a very mixed bond, presents in like manner the units surrounded by headers but widely separated by double-stretcher borders. By a little study, both the diagrams last named may be seen as presenting Unit VI—merely outlined by the headers—enclosing Unit IV. In the one case, the units overlap both vertically and horizontally; in the other, they stand out quite alone.

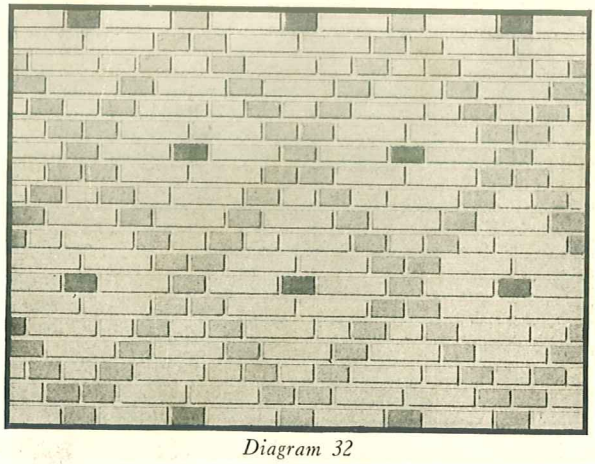


Diagram 32

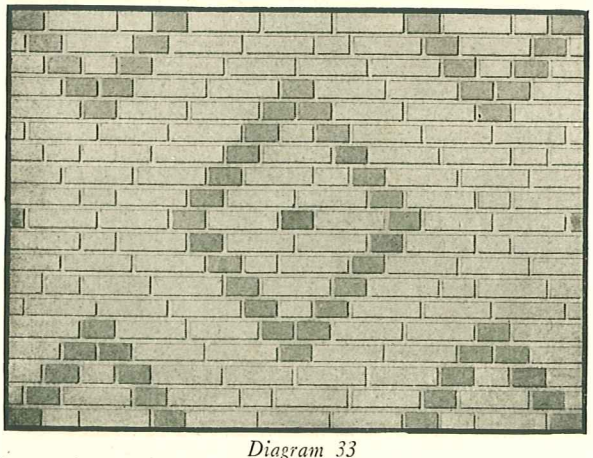


Diagram 33

Diagram 34, a mixed bond, shows Unit V. Here the units, holding in their centers Unit I, are set in exactly diagonal lines

and bordered vertically and horizontally by stretchers; while Diagram 35 presents a Four-Stretcher Garden Wall Bond on which is designed Unit VIII, containing Unit IV, distinguished from each other by color tone. The dovetailed units are separated by a horizontally zigzag line of stretchers.

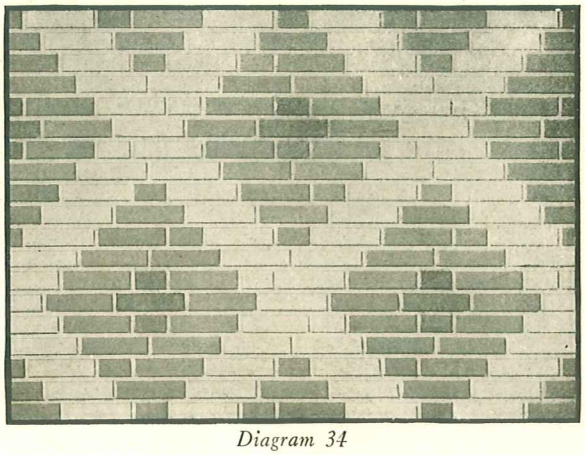


Diagram 34

Diagram 36, on the left side, worked on a bond of alternating Double-Stretcher Garden Wall and stretcher courses, crossed, presents an appearance similar to that of Diagram 35, but does so by the use of Unit IX enclosing Unit V, which in turn bears at its center Unit I, all of them brought out by a difference in color. On the right side, by a change of bond, the contained Unit V is made up of Unit I surrounded by like units.

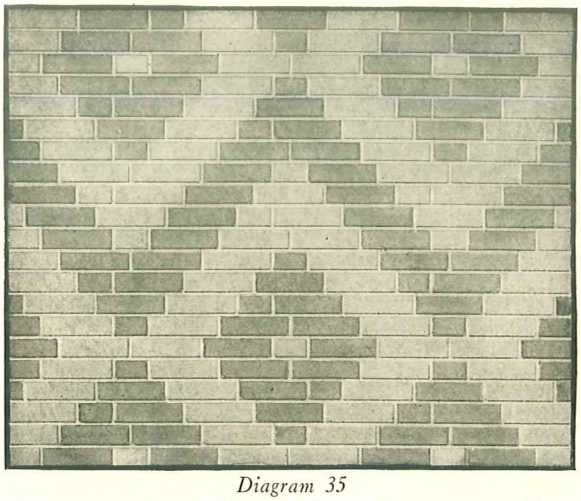


Diagram 35

In leaving this subject, it may be well to observe that the choice of a bond unit and the way in which such bond units are to be distributed on the wall surface, as well as the manner of treating them in color or texture, are matters open to the widest divergence of individual tastes. One designer may be inclined to strong contrasts, while another may treat them with the utmost reserve. But in every case the one aim should be to weave the fabric of the wall in such a way as to make evident its fitness both to the nature of the structure and to its surroundings, natural and artificial.

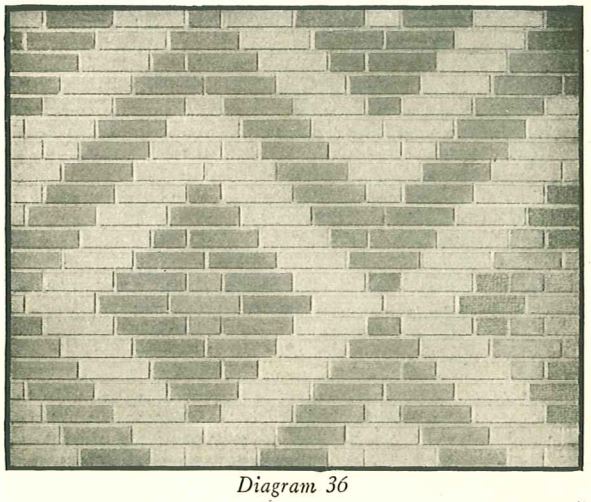


Diagram 36

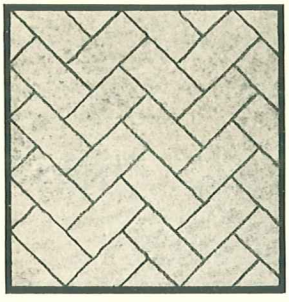


Diagram A

The subject of bond, however, can hardly be dismissed without a word, and a diagram or two, on paving or panelling bonds. They may be illustrated in a few typical forms.

Diagram B

Diagrams A and B show a Herring Bone pattern which may be laid with the brick flat or on edge. Diagrams C and D represent a Basket pattern in its two forms, that is, laid flat or on edge. Diagram E is a Basket pattern laid flat separated by borders laid on edge; while Diagram F shows a Basket pattern laid on the edge separated by borders on the flat.

A SUGGESTION

These bonds and patterns here illustrated are meant to serve as helpful suggestions to the designer in brickwork; his ingenuity and taste may lead to any number of possibilities along the same line. While the methods of bonding, when once a bond is chosen, are strictly governed by mechanical rules, the pattern schemes, a few of which have been presented here, are a matter for the individual taste of the architect or the prospective builder. These diagrams are by no means intended to dictate what may or may not be the true values of color tones in any given bond, what the blendings of light and shade or the contrasts of color and texture in brickwork, but merely as suggestive hints for pattern design.

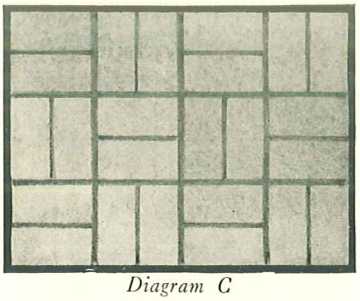


Diagram C

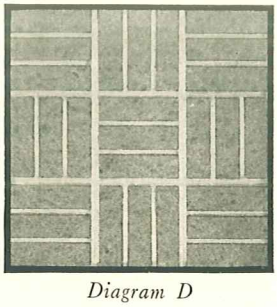


Diagram D

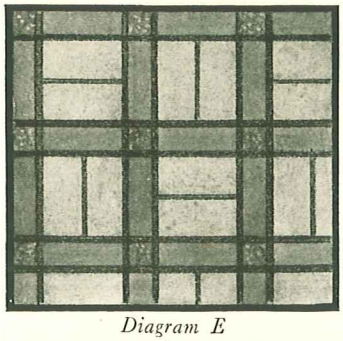


Diagram E

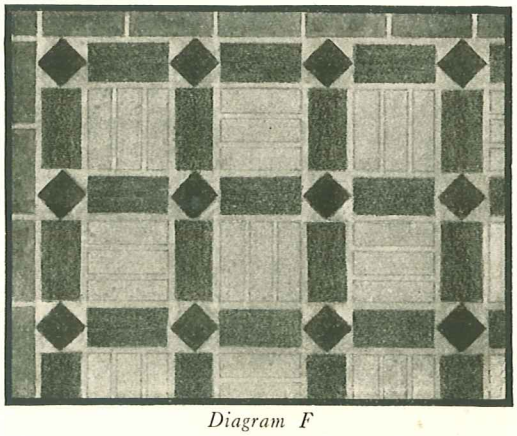


Diagram F

At the same time, an underlying principle is involved in what has been

thus suggestively presented. It will be readily understood that the smaller units, which are worked into patterns of finer texture and quieter shadings, are more appropriate for wall expanses of limited area, while the bolder outlines and heightened contrasts of the larger figures are more suitable for large sweeping wall surfaces.

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II.

One of the most essential elements in brickwork is the mortar in which the bricks are laid. Upon examination of the definition of bond given above, we can see how it might be possible under the most favorable conditions to erect a wall without the use of mortar. In fact, the Greeks in their masonry construction did so erect their marble walls by rubbing the blocks together, after applying sand and water to the joint, until the desired planes were obtained. Thus laid the large blocks of marble, which were of sufficient size and stability to retain their positions in the wall by gravity, made a perfect wall. With our small clay unit of brick, however, there is not sufficient weight to a unit to permit the Greek procedure. Hence mortar is used, and it fulfills the double function of providing for each individual brick a bed in which the irregularities of surface are overcome and, what is still more important, of surrounding each brick with a bonding material which eventually produces a monolithic structure.

Mortar discharges two functions—the one structural, having to do with the nature and composition of the mortar as a bonding material; the other ornamental, affecting the appearance of the joint on the face of the wall, produced by its form, color, and texture.

STRUCTURAL USES OF MORTAR

Viewing the matter from a structural standpoint, it is of fundamental importance to use a thoroughly sound, well tempered, and well mixed mortar, neither too stiff nor too plastic. The proportions of the ingredients should be kept strictly uniform throughout any given job. The building ordinances of every large city dictate the legal composition of mortar to be used in that city.

Generally speaking, mortar is composed of cement and sand, or lime and sand, or cement mortar and lime mortar, mixed in various proportions. But to secure certain desired results, the sand may be partly or entirely replaced by other materials. Thus for a wide joint fine gravel—not over one-fourth inch in diameter—ground granite, or crushed brick is used wholly or in part for the sand. For a white joint, coarsely ground white marble or limestone may be substituted; or for fine joints, which are meant to be very white, pulverized white marble is frequently used.

In any case the material must be of the very best. The cement should pass the proper and usual tests as set forth by the American Society for Testing Materials; the lime should always be fresh and well burned, and of a character which will slake into a smooth and even consistency, without lumps of hard or underburned material; and the sand should be free from loam, pieces of charcoal, iron oxide, or other material of like character.

A great many architects will not permit the use of anything but a purely cement mortar. A number of city ordinances also require that the mortar used shall not be inferior to a mortar composed of one part of Portland cement and three parts of clean sand, thoroughly mixed dry, so as to be of one uniform color, with the proper amount of water added to make a smooth working composition; and shall be used while fresh. Some engineering authorities, however, will permit of as large a proportion as four of sand to one of cement.

The usual practice, especially in the Middle West, is the use of a mixture of lime mortar and cement mortar. A specification for this character of mortar would be as follows—or in similar proportions: "The lime mortar

shall be composed of five bushels of fresh burned lime to one cubic yard of sharp river sand; this mortar to be made up so as to have two weeks' supply ahead of the work—no lime mortar that is not at least two weeks old to be used. The cement mortar is to be composed of one part of American Portland cement (showing a tensile strength of 500 pounds per square inch on seven days' exposure) and three parts of clean sand; the cement mortar to be mixed fresh each day just before being used and in such quantities that none shall be left over at the end of the day's work. Take of the above mortars equal parts, thoroughly mix and use fresh, not allowing the mortar to set before using in the walls." Thus mixed, these mortars when set become a pale gray color, of either a greenish or bluish tint, depending upon the brand of cement used. The effect of lime mortar in the mixture is to produce a much lighter color in the finished joint than is obtained by the use of a pure cement mortar.

ARTISTIC EFFECTS

But being primarily interested in the artistic aspects of brickwork, it is fitting that the form, texture, and color of the joint as it appears on the face of the wall should here be emphasized. The form and color of the mortar joint become an added factor in the development of artistic brickwork and should be used with understanding and skill, since as usually estimated, the surface of the mortar ranges from one-seventh to one-fourth of the whole surface of the completed wall. The entire color scheme of the wall may be changed either by the manner of treating the mortar joint or by the introduction of color into the mortar. Thus the flush joint, that is, the cutting of the mortar flush with the face of the brick, results in a decided line of color, which may be large or small according to the size or width of the joint. Or, to take another example, with the sunk or cut joint, which practically eliminates the color of the mortar altogether, we get a shadow line around each brick.

The study of color in the mortar joint will often enable the designer to bring his entire wall surface into the harmony of color he is striving for. On the other hand, piers and openings may be featured, and architraves and quoins may be produced around an opening or at the angles of the building, by the simple expedient of using a flush joint at these places and a sunk joint on the intermediate surfaces, or the reverse.

Bond pattern in brickwork may be entirely lost by the use of a mortar joint ill-chosen in form or size; while beautiful texture and beautiful pattern may be accentuated through the mere treatment of the joint alone. Or pattern may be brought out in a brick wall of uniform color by the way in which the border joints, enclosing the pattern units, are handled.

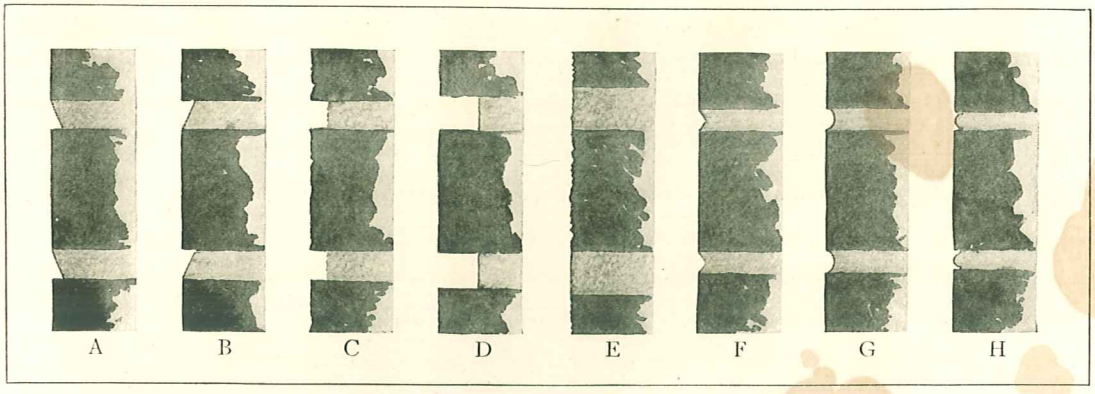
Texture in the joint, that is, the surface of the mortar as it appears to the eye, should harmonize with the texture of the brick. Thus a rough-textured brick is shown to the best advantage by a rough joint. A rough joint however, it must be observed, does not mean an *unworkmanlike* joint. All joints, rough or smooth, should be workmanlike in that they meet the edges of the brick in a clean, sharp manner.

A rough or granulated surface in the joint is obtained by the use of very coarse sand or fine gravel, the face of the joint being either cut with the trowel or scraped with a jointing stick so as to roughen the surface of the mortar. A smooth joint is obtained by the use of a steel jointing tool, or by pressure applied to the toe of the pointing trowel. Large joints should usually be rough surface joints, and, as already indicated, are used to best advantage with rough-textured brick, although beautiful effects may be obtained by using this joint with a smoother or fine-textured brick. Some of the most famous brick designers in this country, however, are of the opinion that all rough-textured brick should have a raked joint, that is, a joint cut back from the face of the brick, often very deeply, "leaving the brick surface thus free to expose its color and texture, and the individual brick to play its part and place as a unit therein."

KINDS OF MORTAR JOINTS

The usual mortar joints in good brickwork are indicated in the accompanying cross-section sketches and photographic reproductions. Joints A and B are trowel-struck joints, and are usually made by the bricklayer as the work progresses, being the common jointing in ordinary brickwork. As American mechanics usually work from the inside of the wall, joint A is the easier joint to strike, while joint B, the so-called weathered joint, requires more care, as the trowel has to be worked from below. But this form of joint is the better able to shed the water and is the more permanent joint of the two.

Joint C is a raked joint, made by removing the surface of the mortar, while it is still soft, with a convenient tool. Joint D shows a set-back, or stripped, joint which is made by laying wooden strips on the top of each course and

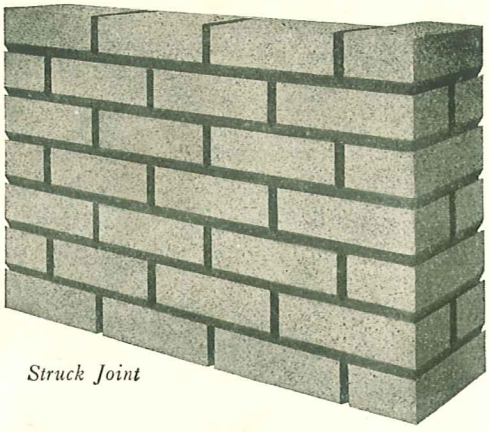


filling up with mortar behind these strips, bedding the brick on the top of the strip which is removed when the mortar is sufficiently hard to sustain the weight of the brick. While the joint stripping adds considerably to the expense, it accomplishes the result of having the bottom edge of the brick on a level line, prevents the smearing of the face with mortar during the course of erection, and generally tends to equalize the horizontal joint. Both the raked and the set-back joint have a tendency to darken the appearance of the wall, owing to the deep shadow which the joint makes on the surface. These joints are very effective and bring out with great distinctness any pattern with which they may be used.

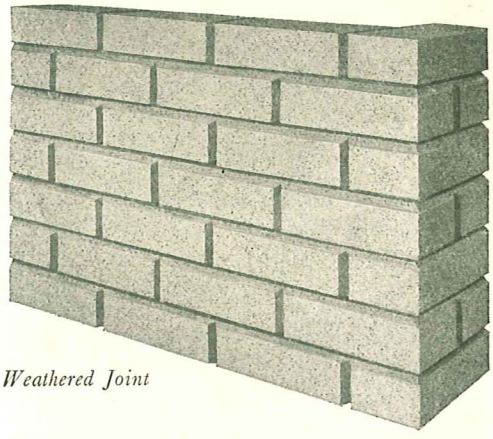
Joint E is a rough-cut flush joint, which is made by cutting off with the trowel the surface mortar projecting beyond the face of the brick. The exposed surface of the mortar must be left just as it is after the excess mortar is cut off, as any repointing or patching of the joint is not only very apparent and breaks the color effect of the surface of the joint, but also is likely to be injured by the action of the elements.

Joints F, G, and H practically belong to the group of pressed brick and smooth surfaces, and are joints that are normally kept quite small. They are better suited to interior work and are formed by the use of a steel jointer which, in order to make the lines true, is drawn along a straight edge.

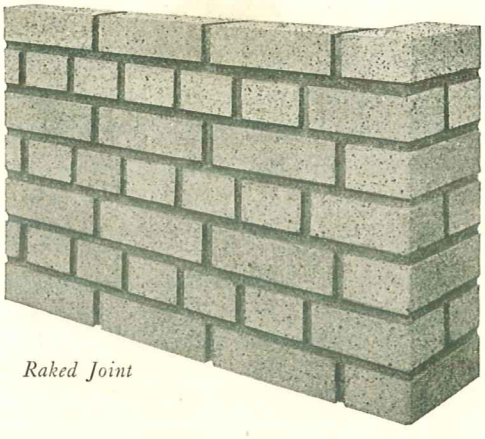
Terrace floors and steps, when built of brick, are usually pointed with what is called a "thumb" joint, which is a broad slightly concave joint thoroughly rubbed down with a steel jointing tool. It is good practice to have the exposed face of brick used for terrace floors and steps given a good coat of raw linseed oil immediately before laying, as this practice prevents the mortar from sticking to the face of the brick and permits of clean, clear, finished work.



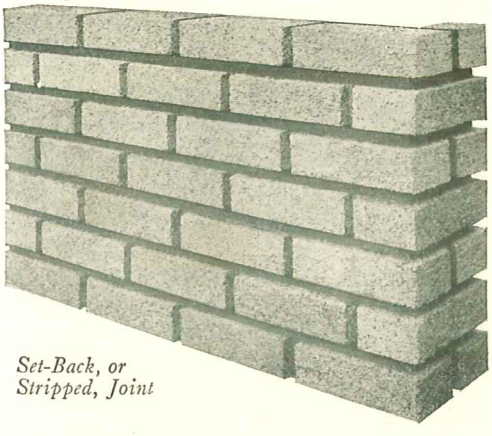
Struck Joint



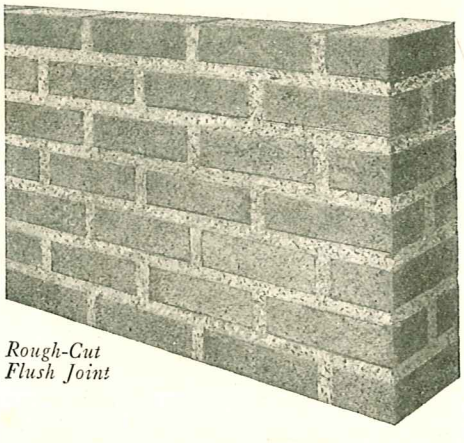
Weathered Joint



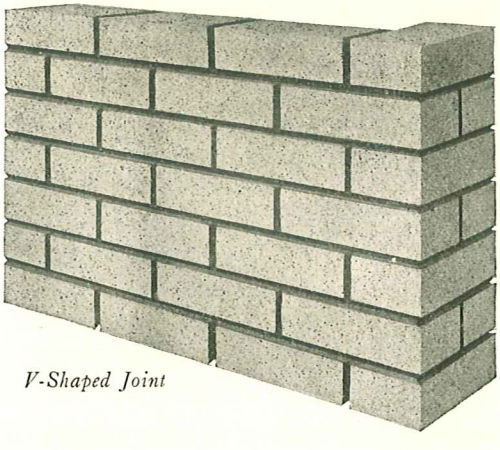
Raked Joint



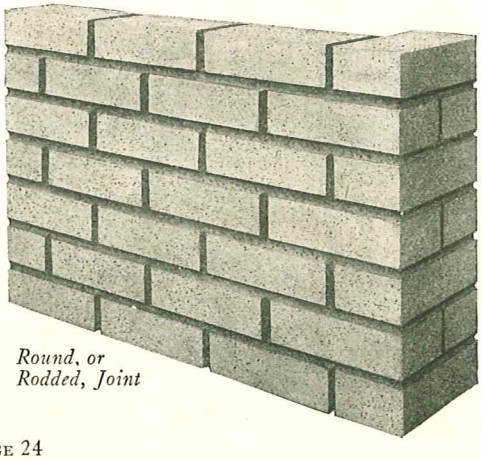
Set-Back, or Stripped, Joint



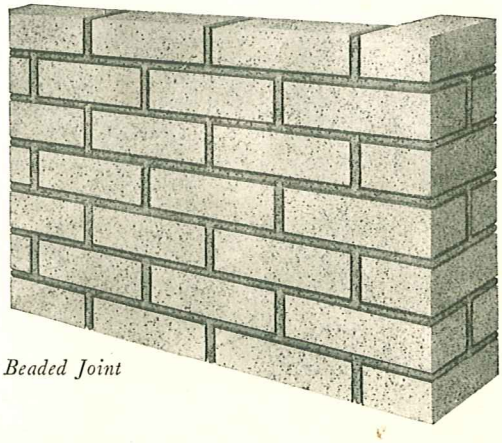
Rough-Cut Flush Joint



V-Shaped Joint



Round, or Rodded, Joint



Beaded Joint

The addition of color to mortar is one of the expedients that is at the command of the designer of artistic brickwork, to produce that nice degree of harmony of the total wall surface so frequently necessary for securing the essential character of his design. Colored mortar is needed to bring out the life and character of certain tones of brick and is in itself a serious study. The color required to harmonize with certain brick tones can only be found by experiment, and that experiment should always consist of laying a section of sample wall in the colored mortar joint as proposed, large enough to permit a judgment on the finished whole.

There are many fine artistic effects that may be secured by the use of artificially colored mortar which harmonizes with color tones and textures in the brick. Two walls laid of absolutely the same kind of brick will present an altogether different appearance if laid in different colored mortars, an effect that is enhanced if, in addition, there are used different forms of joint. In one wall use a rough-cut flush joint of dark mortar, and in the other a light mortar raked out deep, and the observer could hardly be persuaded that the same brick had been used in both walls. But mortar colors, the reader must be advised, are materials rather difficult to deal with, and the greatest care must be taken in their selection, not only to secure just the shade wanted but to avoid using those that are chemically affected by the lime or cement of the mortar. An otherwise beautiful wall may be almost ruined by a false tone of color (artificial or natural) in the joint, while, on the other hand, its beauty may be greatly refined and enhanced by the employment of a harmonious color in the mortar.

METHODS OF USING COLORED MORTAR

There are two methods by which colored mortar may be used. The first is its use as the actual working mortar in which the wall is laid. The second is its use in tuck-pointing the wall at the completion of the job. In rough-textured joints the first method is practically necessary. Where a steel jointer may be used, tuck-pointing becomes much the best method of producing the desired result. Fortunately for the designer, it is seldom necessary to produce vivid or strong color in a rough-textured joint.

The ideal practice would be first to complete the entire wall with an inch-deep raked joint, and then, after cleaning down the work, to tuck-point it in fair weather from one batch of the properly colored mortar, at one time, and in one operation. Some colors more than others, especially blacks, seem to require this care, for the daily stoppages of the work and other delays

show in the bleaching of the last few joints on the top of the unfinished wall, caused by the action of the sun and the elements. But as, in view of the added expense, this is rarely done, the next best expedient is to cover the last few courses at the end of each day's work, and to secure an experienced and conscientious mixer who has the ability and inclination to use exact proportions in reproducing from day to day the uniform batches of colored mortar necessary to complete the work.

THE ARCHITECT'S OPPORTUNITY

Enough has been said—and shown in the diagrams—to suggest the varied artistic possibilities in making the wall of brick an object of beauty. Bonds and mortars do not concern merely the dull prosaic mechanics of cementing bricks together and building them into a strong solid wall; but, treated intelligently in connection with the textures and colors of the bricks themselves, offer the most flattering artistic opportunities. Let the designer in brickwork but know *what* his building is to be and *where* it is to be—a modest or a pretentious dwelling in town or country, a great block in the metropolis or a store in the village street, a city hall, a school of learning, or a temple of worship—and he has within his hands the fine warp and woof of bonds offering their patterns, and of mortars showing their interlacing lines of color, with which to weave the fitting garments of habitation for man.

It speaks well for our American architects that during the past twenty-five years, especially in the last decade, they have shown an intelligent appreciation of the art values in brick by erecting many beautiful buildings in that material; and it is encouraging to recognize not only that their appreciation grows from day to day, but that the owner and builder is more and more becoming aware of the beauties that lie in artistic brickwork. Partly as a cause and partly as a result of this desirable architectural condition, American brick manufacturers have, with the aid of modern invention and scientific discovery, outstripped the rest of the world in the quantity, variety, and quality of their product, thus offering to the architect a building material which is the most natural, plastic, durable, and beautiful for the purposes of his art.

DUNLAP-WARD